THE GRINNELL VARIABLE PRESSURE ALARM VALVE

BY

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A Study

of

THE GRINNELL VARIABLE PRESSURE ALARM VALVE.

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A THESIS

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Approved -

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Fig. 3.

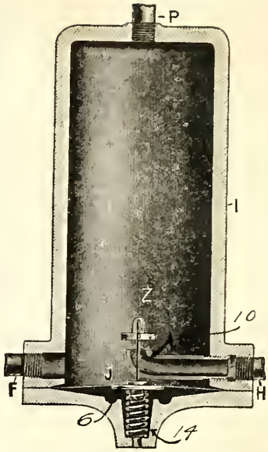

FIGURE 4

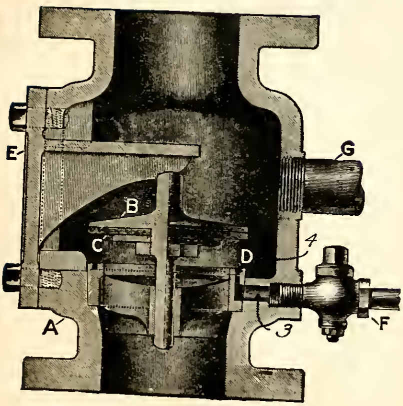

FIGURE 1

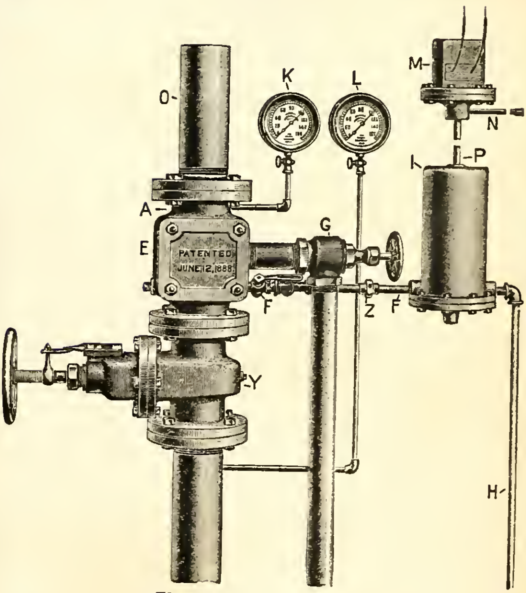

FIGURE 2

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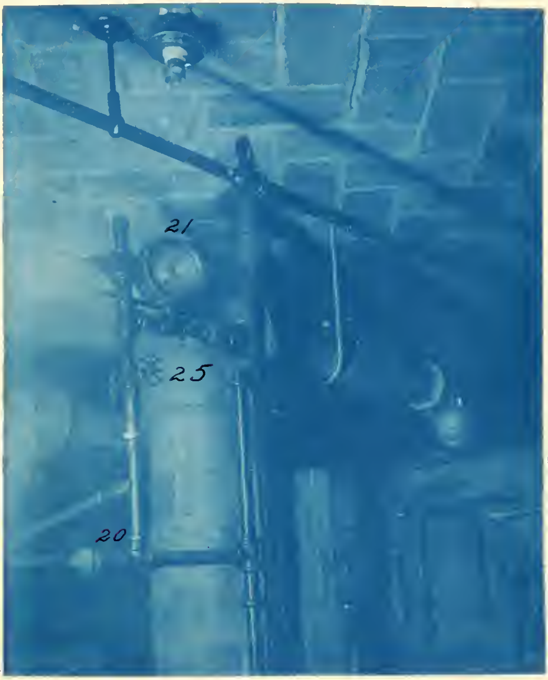

Fig. 5.

THE GRINNELL VARIABLE PRESSURE ALARM VALVE.

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OBJECT.-

To determine the efficiency, the retarding factor, the reliability, conditions modifying these factors and the proper installation of a Grinnell Variable Pressure Alarm Valve, where efficiency is here defined as the ability or power of the valve to produce the effect intended, where the retarding factor is defined as the time elapsing between the first movement of water past the valve due to the opening of a system outlet and the completion of the act by which the valve actuates the alarm devices and where reliability is understood to mean the amount of reliance to be placed upon the valve to produce the effect intended and nothing more.

APPARATUS.-

Grinnell Variable Pressure Alarm Valve of the swing check type; discharge measuring device, including calibrated sprinkler heads as shown in Figure 5; Leak measuring device as shown in Figure 3; Pumps: Air-compressor: Stand-pipe; wrenches, etc.

The sole effect intended in an alarm valve is an alarm whenever there is an escape of liquid from the system of pipes to which the apparatus is connected and in the Grinnell Variable Pressure Alarm Valve the manufacturers produce this effect by increasing the ratio between the areas of the supply and discharge openings of a receiving chamber, whenever the communucation between said chamber and the water supply system remains open a predetermined time-the alarm being operated upon such increase in ratio.

There are two types of the Grinnell Variable Pressure Alarm valve, namely the swing check type and the vertical check type. The one used in these tests was of the former type, while the one shown in the illustrations is of the vertical type, but since this is the only difference in their construction, the description which follows will read on either type.

In the accompanying illustrations Figure 4 is a vertical section of the drip or receiving chamber: Figure 2 is an elevation of the valve and attachments: Figure 1 is a vertical section of the valve.

In the installation shown in Figure 2, a receiving or drip chamber I is connected to a water supply thru a pipe F, one end of which opens into a chamber or passage 3 formed in the casting A, and the other end of which opens into said drip chamber. The communication between the receiving or drip chamber and the system is closed by means of a check valve B, which is seated upon a valve seat D and is normally held thereon by the pressure above said check B, the construction being such that the area of the valve subjected to the pressure above is greater than the area subjected to the pressure under the valve B. The passage 3 communicates with the system thru an annular ring or chamber 4, formed in the valve seat D and arranged to be closed by the check valve B. When the pressure above the valve is reduced to a point below that of the pressure below the valve, as it will, when water is escaping from the system, the check valve B is lifted from its seat, whereupon communication between the system and the receiving chamber is opened, and water flows into the receiving or drip chamber I

until the check D closes.

The drip chamber I is provided near its lower end with a discharge, which in the construction shown consists of a pipe H extending inward from the wall of the chamber and having an upturned end 10. The discharge is normally open, so that any water in the chamber above said discharge may flow freely out of said chamber. The area of the discharge is so proportioned with relation to the area of the supply passage which communicates with the system that the flow of water thru the supply passage under the pressure in the system will be somewhat greater than the flow of water thru the discharge under atmospheric pressure in the chamber. There is therefore a differential accumulation of water in the receiving or drip chamber when the valve D is open which gradually fills the drip chamber. When the accumulation in the drip chamber I reaches a certain point, the diaphragm J whose tendency to descend is resisted by the spring 14, is forced downward carrying with it the valve Z, which is attached to the diaphragm J by means of the spring 6, until the valve Z closes the upturned end 10 of the pipe H, whereupon the ratio between the area of supply and the area of discharge is increased, thus increasing the rate of accumulation in the chamber in case said chamber is not full of water or increasing the pressure in the drip chamber if said chamber is full. Thus the accumulation of water in the chamber is used to cause the increase in ratio and the increased supply or pressure effected in this way to operate an alarm, which may be an electric alarm M, as shown,

or a water motor, or both. G is the draw off valve with pipe for emptying system O. H is the drip pipe from the chamber I. K is a pressure gauge indicating pressure in sprinkler system O, while L is a pressure gauge indicating the pressure in the supply pipe.

The leak measuring device shown in Figure 7 is a device for the purpose indicated in its name. A pipe 15 in the system is provided with a diaphragm inserted between the flanges 16, 16, said diaphragm having a very small opening in the center of same. Directly below this diaphragm one side of a mercury gauge 17 is connected to pipe 15 by means of piping 18 the other side of said mercury gauge being connected above said diaphragm in like manner, provided with pet cocks 19, where necessary. Any leakage past the diaphragm will be indicated by the difference in height of the mercury columns and by referring to the calibration curve of the Leak measuring device or Diaphragm Meter, the leakage can be expressed in gallons. Consequently any operations on the system involving the measurement of discharges may be corrected for leakage, if such a condition exists.

The Discharge measuring device shown in Figure 5 is a device for measuring the water discharged from the system. It consists of the pipe 20, one end of which is connected to the system, the other terminating in a sprinkler head (either one-quarter inch Grinnell Window Sprinkler, five-sixteenth inch Manufactuerers Open Sprinkler, or one-half inch Esty) which has been calibrated so that a reading in pounds on the gauge 21 can be interpeted in gallons from

the calibration curve for the sprinkler head in question.

The remaining apparatus, while essential to the test, might just as well been any other type as the type used. s description of same i. e. pump, air compressor, tanks, standpipe etc is omitted.

METHOD OF OPERATION.-

The data under the caption "Discharge Tests" was obtained as follows:-

The Discharge measuring apparatus (Figure 5) was connected to the system, the system filled with water, the water pressure brought up to 80 pounds by means of the large pump (Quimby screw type) and the system tested for leakage by means of the Diaphragm Meter (Figure 5). To maintain the water pressure at 80 pounds, the small pump was started and the bleeder valve, attached to the system, regulated to keep the water pressure at this point (80 lbs.). A sprinkler head to give th discharge desired was then inserted into the pipe 20 and the valve 25 opened. At the same instant the stop watch was started and by this means the alarm point of both bell and water motor was obtained.

When air pressure tests were desired the system was drained of water, the air pressure brought up to the desired point by means of the air compressor, and the above operation repeated.

The data under the caption "Varying Water Pressure Tests" was obtained as follows:-

The system was filled with water under a pressure of 40 pounds, and by manipulating the pumps the pressure was raised under varying speeds to the limit (130 pounds), unless the alarm was sounded before the limiting point was reached.

When air pressure tests were desired the system was drained of water, placed under the air pressure desired, and filled with water under 40 pounds pressure, whereupon the above operation was repeated.

CONCLUSION.-

It would appear from the study of this valve and the data presented, that the workmanship and general mechanical design is very good; that it is efficient in action; that the action is positive with flow of water equivalent to one sprinkler; that the retarding factor is safe, sensible, reasonable and desirable and that the valve is reliable provided that these factors are not modified by improper installation.

Installation according to Figure 2 is recommended and in addition to this the system should not contain air. For when the system contains air under pressure, as the data obtained indicates, when there was a flow of water from the system, the retarding factor was delayed and in a number of trials the absence of an alarm was noted, but when there was no flow of water from the system and with a gradual increase of pressure (i, e. water), an air cushion materially hastened the alarm. On the other hand when the system was completely filled with water the retarding factor was within the limits noted above, while under varying water pressure it was impossible to get

an alarm. To carry out this recommendation, that the system should be free of air, an air valve should be installed or located in the distributing pipe on each floor corresponding to each riser.

Other features which modified the reliability of this valve were the spitting action, with the resultant waste of water, of the chamber I, and the continuous chattering of the check valve B, at times. These features were not fully investigated, but it is believed that the former can be corrected by reducing the area of the discharge or by closing it altogether and that the latter can be remedied by placing an air cushion below the valve to steady the flow of water. This provision should also be effective in reducing the effect of water hammer.

Respectfully submitted

Walter Eyers

Frank L. Thomson

Discharge Tests.
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Pump Gauge.	Nozzle Gauge.	Discharge Gallons.	Retarding Factor Bell.	Motor.	Air Cushion.	Other Conditions.
80	30 #	15.4	No Alarm(3 min.)		Yes.(40)	Tank out.
80	30	15.4	No Alarm(4 min.)		Yes(30).	Tank out.
80	30	15.4	No Alarm(3 min.)		Yes(25).	Tank out.
80	30	15.4	No Alarm(3 min.)		Yes(20).	Tank out.
80	30	15.4	No Alarm(3 min.)		Yes(15).	Tank out.
80	30	15.4	No Alarm(3 min.)		Yes(10).	Tank out.
80	30	15.4	43 sec.	None.	NO.	Tank out.
80	25	14.	1[illegible] sec.	42 sec.	Yes.	Tank out.
80	25	14.	34 sec.	73 sec.	Yes.	Tank out.
80	20	12.6	23 sec.	45 sec.	Yes.	Tank out.
80	20	12.6	21 sec.	52 sec.	Yes.	Tank in.
80	15	10.87	23 sec.	131 sec.	Yes.	Tank in.
80	15	10.87	12 sec.	72 sec.	Yes.	Tank in.
80	10	9.	30 sec.	None.	Yes.	Tank in.
80	10	9.	27 sec.	None.	Yes.	Tank in.
80	25	14.	8 sec.	13 sec.	No.	Tank out.
80	25	14.	11 sec.	21 sec.	No.	Tank out.
80	20	12.6	9 sec.	20 sec.	No.	Tank out.
80	20	12.6	8 sec.	20 sec.	No.	Tank out.
80	15	10.87	10 sec.	23 sec.	No.	Tank out.
80	15	10.87	9 sec.	24 sec.	No.	Tank out.
80	10	9.	12 sec.	54 sec.	No	Tank out.
80	10	9.	10 sec.	None.	No.	Tank out.
80	10	9.	16 sec.	106 sec.	No.	Tank out.
80	10	9.	10 sec.	32 sec.	No.	Tank out.

Discharge Tests.
(Con.)

Pump Gauge	Nozzle Gauge	Discharge Gallons.	Retarding Bell.	Factor. Motor.	Air Cushion.	Other Conditions.
80	5	6.4	37 sec.	50 sec.	No	Tank out.
80	5	6.4	16 sec.	None.	No.	Tank out.
80	25	14.	30 sec.	None.	110 Gals.	New Tank in.
80	20	12.6	17 sec.	None.	110 Gals.	"
80	25	14.	22 sec.	None.	110 Gals.	"
80	20	12.6	16 sec.	None.	110 Gals.	"
80	15	10.87	7.5 sec.	None.	110 Gals.	"
80	15	10.87	7.5 sec.	None.	110 Gals.	"
80	10	9.	60 sec.	None.	90 Gals.	"
80	10	9.	54 sec.	None.	95 Gals.	"
80	15	10.87	9 sec.	None.	90 Gals.	"
80	15	10.87	52 sec.	None.	90 Gals.	"
80	15	10.87	26 sec.	None.	90 Gals.	"
80	15	10.87	45 sec.	None.	95 Gals.	"
80	15	10.87	23 sec.	None.	95 Gals.	"
80	10	9.	75 sec.	None.	90 Gals.	"
80	10	9.	25 sec.	None.	90 Gals.	"
80	10	9.	25 sec.	None.	90 Gals.	"
80	5	9.	No bell.		90 Gals.	"
80	25	14.	20 sec.	None.	None.	"
80	25	14.	18 sec.	45 sec.	"	"
80	25	14.	24 sec.	25 sec.	"	"
80	25	14.	15 sec.	44 sec.	"	"
80	25	14.	17 sec.	42 sec.	"	"
80	20	[illegible]	17 sec.	40 sec.	"	"

Discharge Tests.
(Con.)
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Pump Gauge.	Nozzle Gauge.	Discharge Gallons.	Retarding Bell.	Factor. Motor.	Air Cushion.	Other Conditions.
80	20	12.6	17 sec.	41 sec.	None.	New tank in.
80	20	12.6	17 sec.	46 sec.	None.	"
80	15	10.97	20 sec.	48 sec.	"	"
80	10	9.	32 sec.	None.	"	"
80	10	9.	30 sec.	"	"	"
80	10	9.	20 sec.	"	"	"
80	20	12.6	17 sec.	30 sec.	"	Old Tank in.
80	20	12.6	26 sec.	41 sec.	"	"
80	20	12.6	26 sec.	36 sec.	"	"
80	15	10.97	21 sec.	31 sec.	"	"
80	15	10.97	26 sec.	33 sec.	"	"
80	15	10.97	15 sec.	25 sec.	"	"
80	10	9.	18 sec.	30 sec.	"	"
80	10	9.	19 sec.	40 sec.	"	"
80	10	9.	43 sec.	53 sec.	"	"
80	10	9.	46 sec.	49 sec.	"	"
80	10	9.	42 sec.	51 sec.	"	"
80	5	6.4	25 sec.	34 sec.	"	"
80	5	6.4	30 sec.	38 sec.	"	"
80	5	6.4.	25 sec.	35 sec.	"	"
80	5	6.4	40 sec.	40 sec.	"	"
80	5	6.4	17 sec.	27 sec.	"	"
80	15	10.97	24 sec.	34 sec.	"	"
80	15	10.97	21 sec.	32 sec.	"	"
80	10	9.	75 sec.	93 sec.	"	"
80	10	9.	24 sec.	36 sec.	"	"

Discharge Tests.
(Con.)
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Pump Gauge.	Nozzle Gauge.	Discharge Gallons.	Retarding Factor. Bell.	Retarding Factor. Motor.	Air Cushion.	Other Conditions.
80	5	6.4	116 sec.	130 sec.	None.	New tank in.
80	5	6.4	36 sec.	4[illegible] sec.	"	"
80	5	6.4	4[illegible] sec.	61 sec.	"	"
80	5	6.4	60 sec.	75 sec.	"	"
80	15	5.58	79 sec.	92 sec.	"	"
80	15	5.58	75 sec.	91 sec.	"	"
80	10	4.54	None.		"	"
80	10	4.54	10[illegible] sec.	11[illegible] sec.	"	"
80	10	4.54	None.		"	"

Varying Water Pressure Tests.

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Water Gauge.	Nozzle Gauge.	Discharge Gallons.	Retarding Bell.	Factor. Motor.	Air Pressure.	Other Conditions.
20-40	0	0	52 sec.	None.	None.	New tank in.
40-53	0	0	25 sec.	"	"	"
50-60	0	0	16 sec.	"	"	"
60-70	0	0	17 sec.	"	"	"
70-80	0	0	14 sec.	"	"	"
85-100	0	0	None.	"	"	"
40-54	0	0	21 sec.	"	"	"
50-[illegible]0	0	0	10 sec.	"	"	"
60-70	0	0	17 sec.	"	"	"
70-80	0	0	12 sec.	"	"	"
80-95	0	0	18 sec.	"	"	"
80-100	0	0	None.	"	"	"
40-50	0	0	23 sec.	"	"	"
50-57	0	0	12 sec.	"	"	"
60-70	0	0	17 sec.	"	"	"
70-83	0	0	26 sec.	"	"	"
80-100	0	0	None.	"	"	"
40-52	0	0	27 sec.	"	"	"
50-60	0	0	15 sec.	"	"	"
60-78	0	0	30 sec.	"	"	"
70-86	0	0	21 sec.	"	"	"
80-100	0	0	None	"	"	"
40-50	0	0	27 sec.	"	"	"
50-60	0	0	40 sec.	"	"	"
60-7[illegible]	[illegible]	0	44 sec.	"	"	"
70-95	0	0	None.	"	"	"

Varying Water Pressure Tests.
(Con.)
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Water Gauge.	Nozzle Gauge.	Discharge Gallons.	Retarding Bell.	Factor. Motor.	Air Pressure.	Other Conditions.
40-50	0	0	32 sec.	None.	None.	New tank in.
50-63	0	0	40 sec.	"	"	"
60-70	0	0	None.	"	"	"
40-80	0	0	" (4 min.)	"	40	No tanks in.
38-80	0	0	"	"	30	"
40-80	0	0	"	"	20	"
40-90	0	0	"	"	15	"
40-80	0	0	"	"	10	"
40-63	0	0	"		5	"
40-90	0	0	"	"	5	"
40-90	0	0	"	"	5	"
40-80	0	0	"	"	0	"
40-83	0	0	"	"	0	"
40-90	0	0	"	"	0	"
40-80	0	0	"	"	0	Small Pump Tank
40-80	0	0	"	"	0	in-air compressed
40-80	0	0	"	"	0	in same.
40-95	0	0	"	"	0	"
40-100	0	0	"	"	0	"
40-110	0	0	"	"	0	"
39-110	0	0	"	"	0	"
49-110	0	0	"	"	0	"
35-110	0	0	"	"	0	"
39-110	0	0	"	"	0	"
45-110	0	0	"	"	0	"

Varying Water Pressure Tests.
(Con.)

Water Gauge.	Nozzle Gauge.	Discharge Gallons.	Retarding Factor. Bell	Retarding Factor. Motor.	Air Pressure.	Other Conditions.
40-120	0	0	None.	None.	0	"
40-120	0	0	"	"	0	"
40-120	0	0	"	"	0	"
40-120	0	0	"	"	0	"
42-120	0	0	"	"	0	"
40-120	0	0	"	"	0	"
40-120	0	0	"	"	0	"
40-120	0	0	"	"	0	"
40-120	0	0	"	"	0	"
40-120	0	0	"	"	0	"
40-70	0	0	3 sec.	10 sec.	5	Old Tank in. Pump Tank in.
40-60	0	0	1 sec.	None.	10	"
36-50	0	0	6 sec.	10 sec.	15	"
40-50	0	0	6 sec.	10 sec.	5	"
40-50	0	0	8 sec.	10 sec.	5	"
35-50	0	[illegible]	8 sec.	12 sec.	10	"
38-50	0	0	10 sec.	19 sec.	10	"
35-50	0	0	13 sec.	21 sec.	15	"
35-50	0	0	10 sec.	17 sec.	10	"
40-100	0	0	None.	None.	0	"
40-100	0	0	"	"	0	"